Advances in Environmental Research, *Vol. 4, No. 3 (2015) 173-181*
DOI: http://dx.doi.org/10.12989/aer.2015.4.3.173

Simultaneous water and energy saving of wet cooling towers, modeling for a sample building

Abtin Ataei [*1,2], Jun-Ki Choi [2], Zeinab Hamidzadeh [1] and Navid Bagheri [1]

[1] *Department of Energy Engineering, Graduate School of the Environment and Energy, Science and Research Branch, Islamic Azad University, Tehran, Iran*
[2] *Department of Mechanical and Aerospace Engineering, University of Dayton, Dayton, Ohio, USA*

(*Received July 09, 2015, Revised July 17, 2015, Accepted July 19, 2015*)

Abstract. This article outlines a case study of water and energy savings in a typical building through a modelling process and analysis of simultaneous water-energy saving measures. Wet cooling towers are one of the most important equipments in buildings with a considerable amount of water and energy consumption. A variety of methods are provided to reduce water and energy consumption in these facilities. In this paper, thorough the modeling of a typical building, water and energy consumption are measured. Then, After application of modern methods known to be effective in saving water and energy, including the ozone treatment for cooling towers and shade installation for windows, i.e. fins and overhangs, the amount of water and energy saving are compared with the base case using the Simergy model. The annual water consumption of the building, by more than 50% reduction, has been reached to 500 cubic meters from 1024 cubic meters. The annual electric energy consumption has been decreased from 405,178 kWh to 340,944 kWh, which is about 16%. After modeling, monthly peak of electrical energy consumption of 49,428 has dropped to 40,562 kWh. The reduction of 18% in the monthly peak can largely reduce the expenses of electricity consumption at peak.

Keywords: water and energy saving; water and energy modeling; wet cooling towers; Simergy model

1. Introduction

In recent years, with the development of the urban construction industry, water and energy consumption in buildings has increased significantly. Saving water and energy can be an important step in achieving sustainable development in this industry (Alshamrani *et al*. 2014). Due to the fact that the role of wet cooling towers is to dissipate heat from the building's cooling system by contact of air and water, these equipments are the simultaneous water and energy consumers (Gude 2015). Simulation of the energy system of the building puts forward an appropriate approach to forecast and analyze the retrofit actions (Alaidroos and Krarti 2015, Rhodes *et al*. 2015).

It is estimated that about 768 million people around the world do not have access to good quality water (Walsh *et al*. 2015). Water, as the main component of every cooling system,

*Corresponding author, Associate Professor, Ph.D., E-mail: abtinataei@gmail.com

http://www.techno-press.org/?journal=aer&subpage=7 ISSN: 2234-1722 (Print), 2234-1730 (Online)

for structure and envelope systems of school buildings", *Build. Environ.*, **80**, 61-70.
Ataei, A., Gharaie, M., Parand, R. and Panjeshahi, E. (2010), "Application of ozone treatment and pinch technology in cooling water systems design for water and energy conservation", *Int. J. Energ. Res.*, **34**(6), 494-506.
Boji, M. (2006), "Application of overhangs and side fins to high-rise residential buildings in Hong Kong", *Civil Eng. Environ. Syst.*, **23**(4), 271-285.
Conner, A. (2005), "Reducing cooling towers cost with the ozone technology", *Clean Water Ozone Systems*, Inc.
Ebrahimpour, A. and Maerefat, M. (2008), "Application of advanced glazing and overhangs in residential buildings", *Energ. Convers. Manage.*, **52**(1), 212-219.
Energyplus (2014) http://www.energyplus.gov/
Gude, V.G. (2015), "Energy and water autarky of wastewater treatment and power generation systems", *Renew. Sust. Energ. Rev.*, **45**, 52-68.
Haves, P., See, R. and Settlemyre, K. (2014), "Simergy – A graphicaluser interface for energyplus", Public interest energy research program; Final project report.
Heikkila, P. and Milosavljevic, N. (2001), "A comprehensive approach to cooling tower design", *Appl. Therm. Eng*, **21**(9), 899-915.
Maestre, I.R., Blázquez, J.L.F., Gallero, F.J.G. and Cubillas, P.R. (2015), "Influence of selected solar positions for shading device calculations in building energy performance simulations", *Energ. Buildings*, **101**, 144-152.
Panjeshahi, M.H. and Ataei, A. (2008), "Application of an environmentally optimum cooling water system design to water and energy conservation", *Int. J. Environ. Sci. Tech.*, **5**(2), 251-262.
Panjeshahi, M.H., Ataei, A., Gharaie, M. and Parand, R. (2009), "Optimum design of cooling water systems for energy and water conservation", *Chem. Eng. Res. Des.*, **87**(2), 200-209.
Parker, S.A. (1998), *Ozone Treatment For Cooling Tower*, The U.S. Department of Energy; Fed. Tech. Alert J., New York, NY, USA.
Rhodes, J.D., Gorman, W.H., Upshaw, C.R. and Webber, M.E. (2015), "Using BEopt (Energy Plus) with energy audits and surveys to predict actual residential energy usage", *Energ. Buildings*, **86**, 808-816.
Viera, M.R., Guiamet, P.S., de Melle, M.F.L. and Videla, H.A. (2000), "Use of dissolved ozone for controlling planktonic and sessile bacteria in industrial cooling systems", *Int. Biodeter. Biodegr.*, **44**(4), 201-207.
Walsh, B.P., Surray, S.N. and O'Sullivan, D.T.J. (2015), "The water energy nexus, an ISO 50001 water case study and the need for a water value system", *Water Resour. Ind.*, **10**, 15-28.

WL